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STANDARD OPERATING PROCEDURE

Dissolved Oxygen Measurement, Meter Calibration and Maintenance

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STANDARD OPERATING PROCEDURE
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1.0 INTRODUCTION

1.1 Purpose

To provide standardized instruction for the operation of the Yellow Springs Instruments (YSI) model 57 and 58 dissolved oxygen meters with a model 5739 probe.

1.2 Scope

This document will provide specific instructions for meter and probe preparation, probe reconditioning, calibration, dissolved oxygen measurement in the field, and instrument storage.

2.0 MATERIALS

2.1 Dissolved oxygen meter model 57 or 58
2.2 Probe model 5739
2.3 KCl solution (electrolyte)
2.4 Standard size Teflon® membrane (0.1 mm)
2.5 O-ring
2.6 Pencil with eraser
2.7 Distilled Water
2.8 Razor blade or scissors
2.9 Sanding tool
2.10 Adhesive sanding disk
2.11 3% ammonia solution (standard household ammonia)
2.12 Extra batteries (size "C" for model 57 and size "D" for model 58)
2.13 Flathead screwdriver
2.14 Humidity chamber

3.0 PROCEDURES

3.1 Laboratory Probe Preparation/Routine Maintenance

Always handle membrane material carefully, touching at the ends only. Replace KCl solution and membrane when the membrane appears damaged, if bubbles appear under membrane or if erratic readings occur.

3.1.1 Detach probe cord from meter. Unscrew the sensor guard, remove the O-ring and membrane, then thoroughly rinse the sensor with distilled water.

3.1.2 Rinse the sensor with KCl solution to remove distilled water.

3.1.3 Successively fill the sensor body with KCl solution while pumping the diaphragm with the eraser end of a pencil. Be very careful to avoid damaging the diaphragm and probe. Continue filling and pumping until no air bubbles appear.

3.1.4 Secure a Teflon® membrane between your thumb and the probe body. Add more KCl solution to the probe until a large meniscus covers the gold cathode.

3.1.5 With the other hand, grasp the end of the membrane and with a continuous motion stretch it up, over and down the other side of the sensor.

3.1.6 Secure the end of the membrane under your forefinger, and roll the O-ring over the edge of the probe, being careful not to touch the membrane surface. The membrane should not contain fingerprints or wrinkles, and there should be no air bubbles under the surface. Slight wrinkles can be removed by gently tugging on the excess membrane, thereby slipping under the O-ring.

3.1.7 Trim off excess membrane with scissors or a razor, ensuring that the stainless steel temperature rod is not covered by excess membrane.

3.1.8 Shake off excess electrolyte, rinse with distilled water and reinstall the sensor guard.

3.2 Probe Reconditioning

The condition of the gold cathode and silver anode are essential to successful calibration and obtaining an accurate dissolved oxygen reading. Recondition the probe if the gold cathode looks dull and tarnished or the silver anode has been contaminated (grayish).

3.2.1 Detach probe cord from meter. Unscrew the sensor guard, remove the O-ring and membrane, then thoroughly rinse the sensor with distilled water.

3.2.2 Examine the sanding tool carefully for nicks and scratches. Replace if damaged.

3.2.3 Remove the backing from a new sanding disk and affix the adhesive side to the concave tool surface. Make sure that the disk is centered and contains no wrinkles.

3.2.4 Wet the disk with deionized water and place the abrasive face uniformly against the probe face. Slowly rotate the tool back and forth until all tarnish is removed and the gold appears bright. Excessive abrasion with shorten the life of the cathode.

3.2.5 Peel off the used disk and remove any adhesive residue from the sanding tool. Never reuse any sanding disk.

3.2.6 Rinse the probe surface with deionized water and soak the probe overnight in a 3% ammonia solution to decontaminate the anode.

3.2.7 Prepare the probe for use as described above in section 3.1.

3.3 On-site meter preparation for model 57

3.3.1 With the central meter dial set to **OFF**, adjust the meter pointer to zero with the screw in the center of the meter's display panel.

3.3.2 Attach the prepared probe to the **PROBE** connector on the meter and adjust the retaining ring so that it is finger tight.

3.3.3 Turn the meter on 15 minutes before calibrating for optimum probe stabilization. The meter is on when the central dial is set to **RED LINE**. The meter must remain ON until the final dissolved oxygen measurement is made for the day.

3.3.4 After reaching optimum probe stabilization, place the meter in the intended operating position. Readjustments may be necessary if the position of the meter changes.

3.3.5 Adjust **RED LINE**. While the central dial is on RED LINE adjust the RED LINE control knob until the meter needle aligns with the red mark at the 31 °C position. Use the needles reflection in the mirror on the display panel to ensure that you are looking at the display panel straight on. When the batteries need to be replaced, the red lines will not align.

3.3.6 Switch the central dial to **ZERO** and adjust to zero with the ZERO control knob.

3.4 On-site meter preparation for model 58

Model 58 has a digital display panel and does not use a RED LINE adjustment.

3.4.1 Attach the prepared probe to the **PROBE** connector on the meter and adjust the retaining ring so that it is finger tight.

3.4.2 Turn the meter on 15 minutes before calibrating for optimum probe stabilization. A wait is necessary whenever the meter has been OFF or the probe has been disconnected. The meter must remain ON until the final dissolved oxygen measurement is made for the day.

3.4.3 ZERO the instrument. Set the central dial switch to **ZERO** and with the **O_2 ZERO** control knob adjust the display to read 00.0.

3.4.4 Set **SALINITY** knob to **FRESH**. This is the general rule when sampling fresh surface waters. If sampling different types of water, refer to operating manual.

4.0 Calibration

Calibration should take place at each site where a dissolved oxygen measurement is necessary. Take temperature with alternate source, when available, (ex. EC meter) due to inaccuracy of DO temperature rod. This will give you the temperature reading you are trying to achieve on the DO meter and what temperature to calibrate for.

4.1 Calibration and DO measurements with model 57

4.1.1 Secure probe in a modified humidity chamber with a damp cloth or sponge.

4.1.2 Switch the central dial from ZERO to **TEMP**.

4.1.3 Set **SALINITY** control to **FRESH**.

4.1.4 Place probe (still in humidity chamber) in well mixed area of sampling site and wait for temperature to stabilize as close as possible to alternate temperature taken.

Take the temperature reading on °C scale.

4.1.5 Using the solubility of oxygen in water chart (**Table I**), record the maximum solubility for the measured water temperature in mg/L. Account for altitude or barometric pressure, if necessary, using section 4.3.

4.1.6 Switch central dial to **CALIBRATE** in the 0-20 mg/L range. Adjust the CALIBRATE control knob to the value determined in 4.1.5. Use 0-20 mg/L range as a general rule. If the protocol states a different range, follow the protocol.

4.1.7 Take probe out of water. Remove probe from humidity chamber. If the chamber is filled with water (or if the membrane is in contact with water), repeat calibration.

4.1.8 Place probe back into well mixed water and wait for probe equilibration by observing a stable dissolved oxygen reading for a full minute.

4.1.9 Take dissolved oxygen reading in the 0-20 mg/L scale and record in mg/L.

4.2 Calibration and DO measurements with model 58

4.2.1 Secure probe in a modified humidity chamber with a damp cloth or sponge.

4.2.2 Switch central dial to **TEMP**.

4.2.3 Place probe (still in the humidity chamber) in well mixed area of sampling site and wait for temperature to stabilize as close as possible to alternate temperature taken. Take temperature reading on °C scale.

4.2.4 Using the solubility of oxygen in water chart (**Table I**), record the maximum solubility for the measured water temperature in mg/L. Account for altitude or barometric pressure, if necessary, using section 4.3.

4.2.5 Switch the central dial to 0.01 mg/L. Use 0.01 mg/L as a general rule. If this differs from the protocol, follow the protocol.

4.2.6 If locked, unlock locking ring and adjust the **O_2 CALIB** knob to the value determined in section 4.2.4. Wait two minutes to verify stability; use locking ring to prevent inadvertent changes.

4.2.7 Take probe out of water. Remove probe from humidity chamber. If the chamber is filled with water (or if the membrane is in contact with water), repeat calibration.

4.2.8 Place probe back into well mixed water and wait for probe equilibration by observing a stable dissolved oxygen reading for a full minute.

4.2.9 Record the dissolved oxygen reading from the display panel in mg/L.

4.3 Accounting for altitude or barometric pressure

4.3.1 Use pressure/altitude chart (**Table II**) to determine the atmospheric correction factor.

4.3.2 Multiply the maximum solubility value (mg/L) from **Table I** by the Calibration Value (%) from **Table II**. Record.

4.3.3 Adjust the calibration knob to the corrected value.

4.3.4 Proceed with step 4.1.6 for model 57 and step 4.2.6 for model 58.

6.0 Meter/Probe storage

6.1 Between measurements and when en route to or from the field, keep the probe in the modified humidity chamber.

6.2 Upon return to the lab, disconnect the probe from the meter, remove humidity chamber, rinse with deionized water, and place probe in a flask containing water. Make sure the membrane does not come in contact with the water and that there is a good seal between the flask and probe body. Use a parafilm sheet around flask and probe to ensure a good seal, which will help maintain the relative humidity in the flask near 100%.

TABLE I. SOLUBILITY OF OXYGEN IN WATER EXPOSED TO WATER SATURATED AIR AT 760 mm Hg PRESSURE

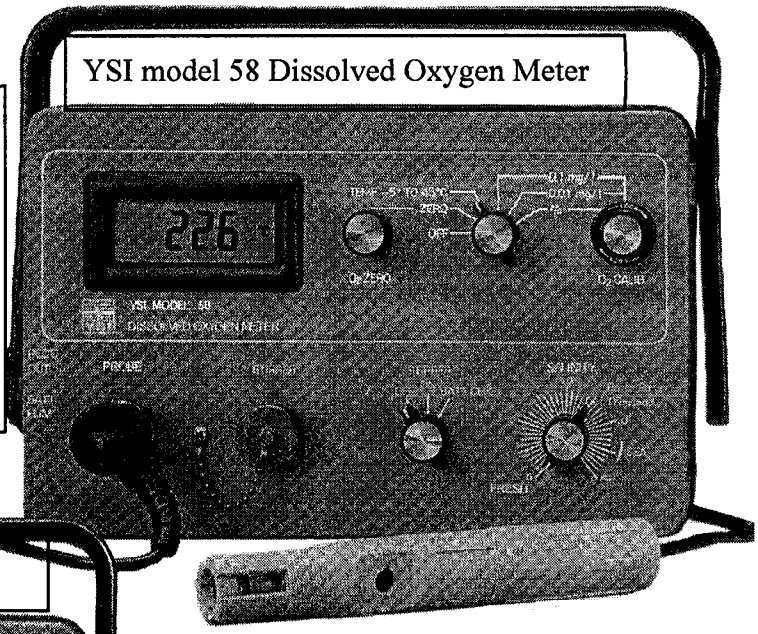
TEMP °C	SOLUBILITY mg/L	TEMP °C	SOLUBILITY mg/L	TEMP °C	SOLUBILITY mg/L
0	14.62	16	9.87	32	7.31
1	14.22	17	9.67	33	7.18
2	13.83	18	9.47	34	7.07
3	13.46	19	9.28	35	6.95
4	13.11	20	9.09	36	6.84
5	12.77	21	8.92	37	6.73
6	12.45	22	8.74	38	6.62
7	12.14	23	8.58	39	6.52
8	11.84	24	8.42	40	6.41
9	11.56	25	8.26	41	6.31
10	11.29	26	8.11	42	6.21
11	11.03	27	7.97	43	6.12
12	10.78	28	7.83	44	6.02
13	10.54	29	7.69	45	5.93
14	10.31	30	7.56	46	5.84
15	10.08	31	7.43	47	5.74

TABLE II. CALIBRATION VALUES FOR VARIOUS ATMOSPHERIC PRESSURES AND ALTITUDES

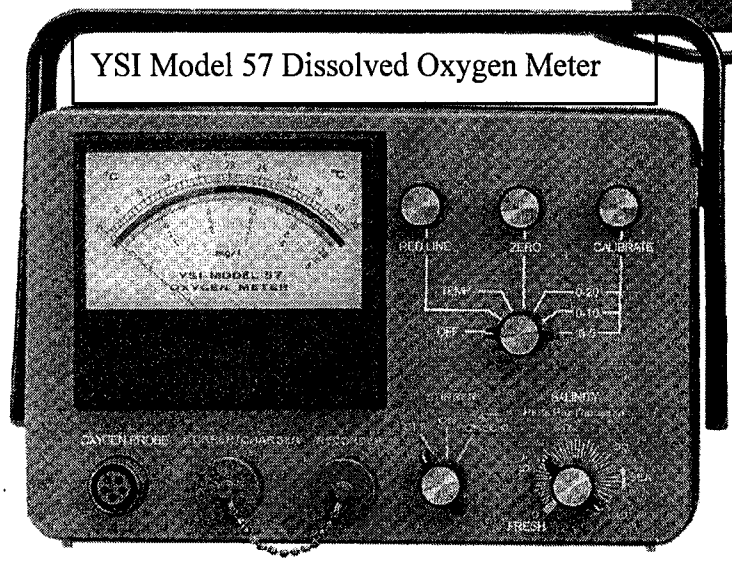
PRESSURE			ALTITUDE		CALIBRATION
INCHES Hg	mm Hg	kPa	Ft.	m	VALUE (%)
30.23	768	102.3	-276	-84	101
29.92	760	101.3	0	0	100
29.61	752	100.3	278	85	99
29.33	745	99.3	558	170	98
29.02	737	98.3	841	256	97
28.74	730	97.3	1126	343	96
28.43	722	96.3	1413	431	95
28.11	714	95.2	1703	519	94
27.83	707	94.2	1995	608	93
27.52	699	93.2	2290	698	92
27.24	692	92.2	2587	789	91
26.93	684	91.2	2887	880	90
26.61	678	90.2	3190	972	89
26.34	669	89.2	3496	1066	88
26.02	661	88.2	3804	1160	87
25.75	654	87.1	4115	1254	86
25.43	646	86.1	4430	1350	85
25.12	638	85.1	4747	1447	84
24.84	631	84.1	5067	1544	83
24.53	623	83.1	5391	1643	82
24.25	616	82.1	5717	1743	81
23.94	608	81.1	6047	1843	80
23.62	600	80.0	6381	1945	79
23.35	593	79.0	6717	2047	78
23.03	585	78.0	7058	2151	77
22.76	578	77.0	7401	2256	76
22.44	570	76.0	7749	2362	75
22.13	562	75.0	8100	2469	74
21.85	555	74.0	8455	2577	73
21.54	547	73.0	8815	2687	72
21.26	540	71.9	9178	2797	71
20.94	532	70.9	9545	2909	70
20.63	524	69.9	9917	3023	69
20.35	517	68.9	10293	3137	68
20.04	509	67.9	10673	3253	67
19.76	502	66.9	11058	3371	66

Model 58 has a digital display, making this model easier to calibrate and record data. This model only needs to be zeroed once and does not have a red line function. There are three calibration choices, including a % reading. Generally use 0.01mg/L to get a reading two places after the decimal point. Set salinity dial to fresh.

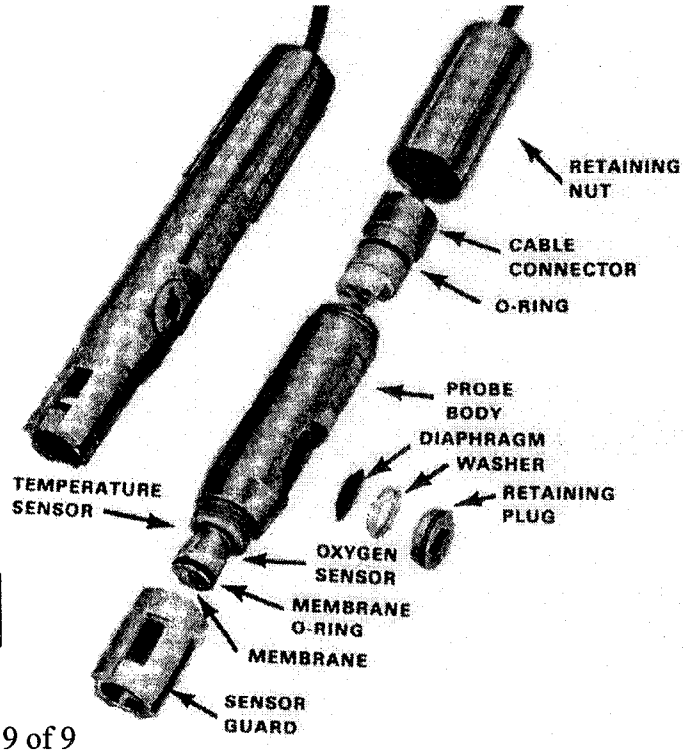
YSI model 58 Dissolved Oxygen Meter



YSI Model 57 Dissolved Oxygen Meter



Model 57 differs from model 58 in two ways. First, there is a screw on the display panel that must be zeroed before the meter is turned on. Also, the meter must be red lined to ensure calibration accuracy. This meter has three calibration ranges to choose from. Generally use 0-20 mg/L. Set salinity dial to fresh.



YSI Model 5739 Probe